10/551439

Fig.1

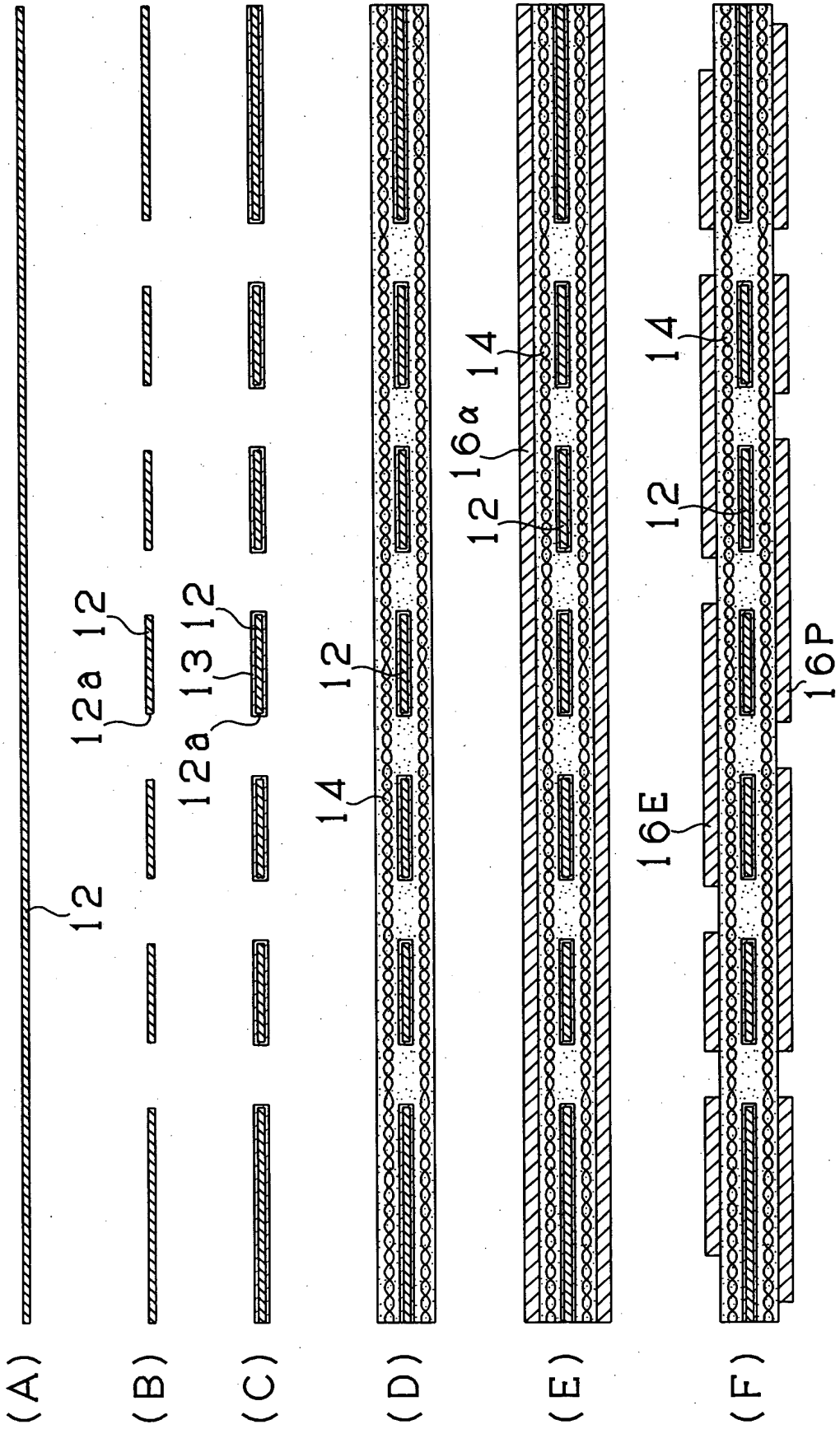
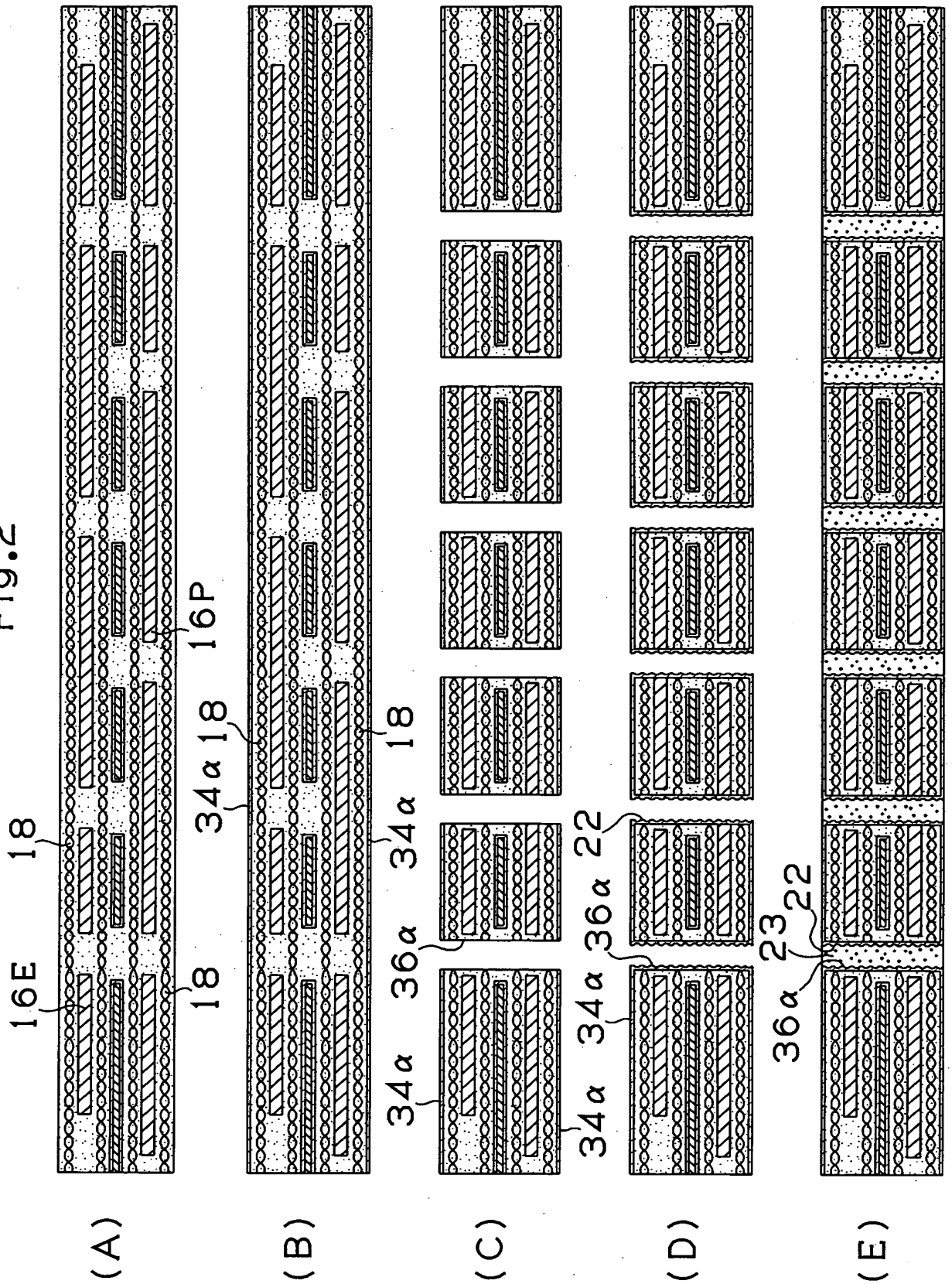


Fig.2


16E
18
18
16P
34α
18
34α
18
34α
36α
34α
34α
22
36α
34α
23
22
36α
(A)
(B)
(C)
(D)
(E)

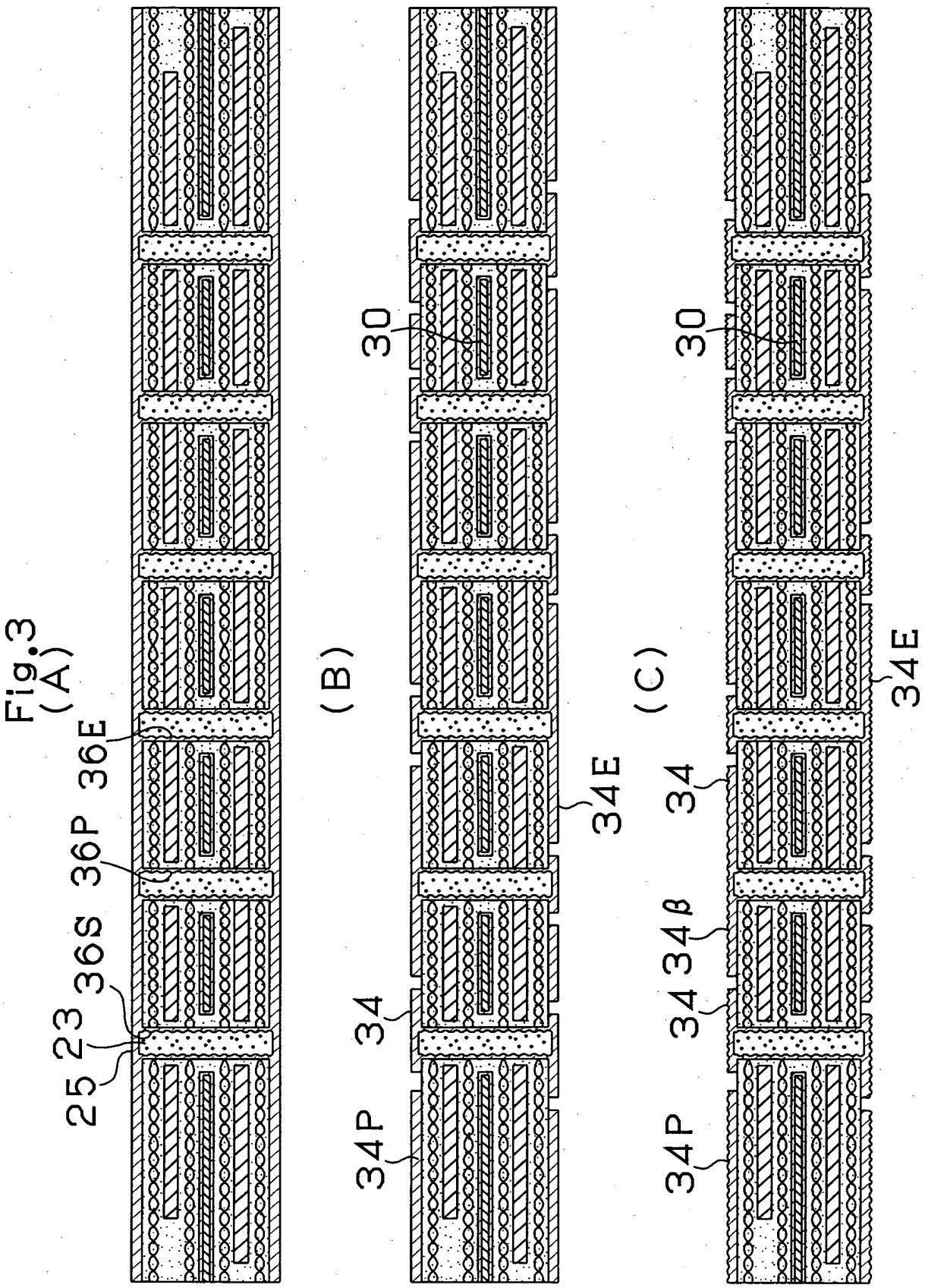


Fig.3
(A)
(B)
(C)
25
23
36S
36P
36E
34P
34
34E
30
34β
34E

Fig.4

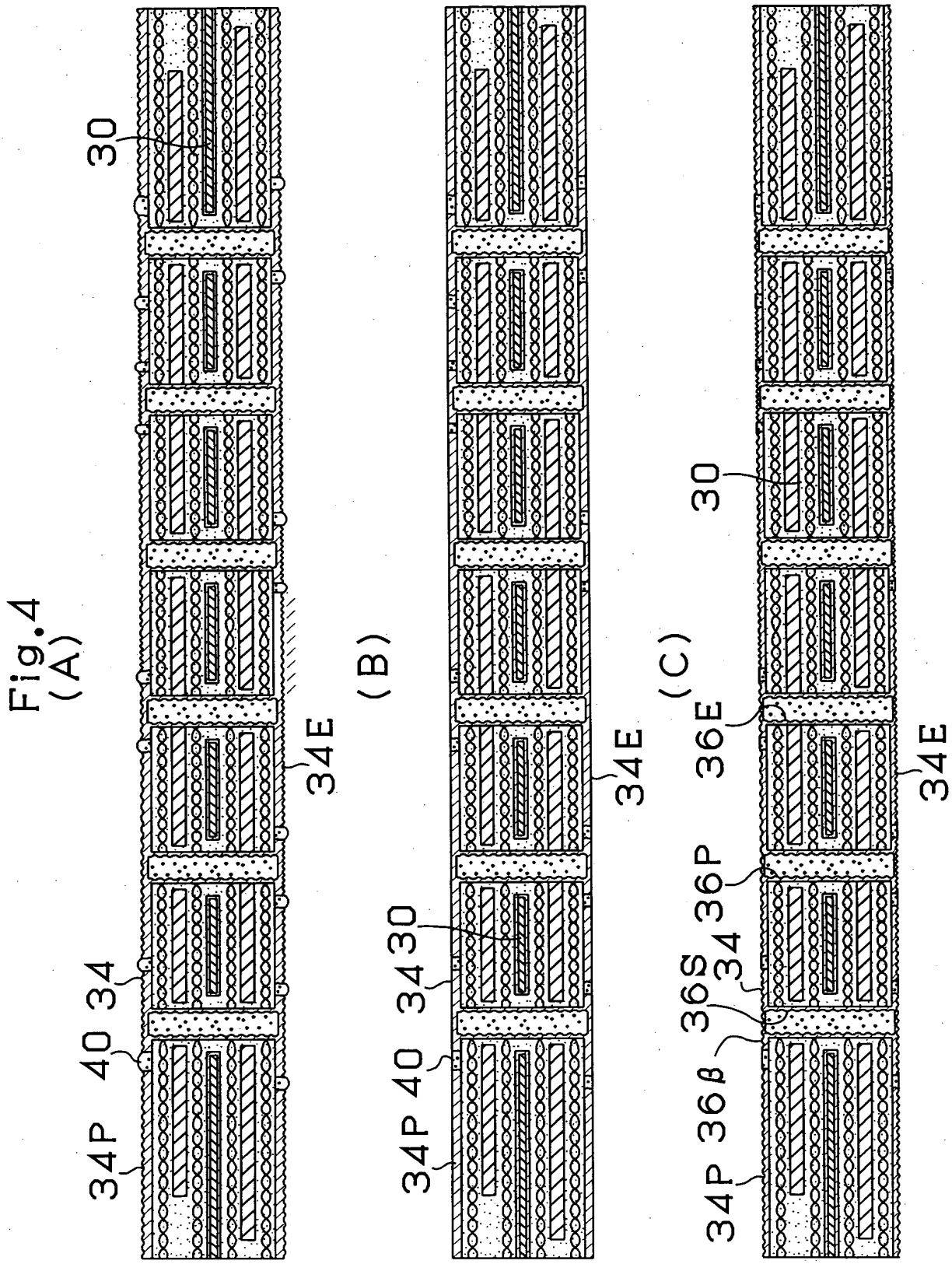


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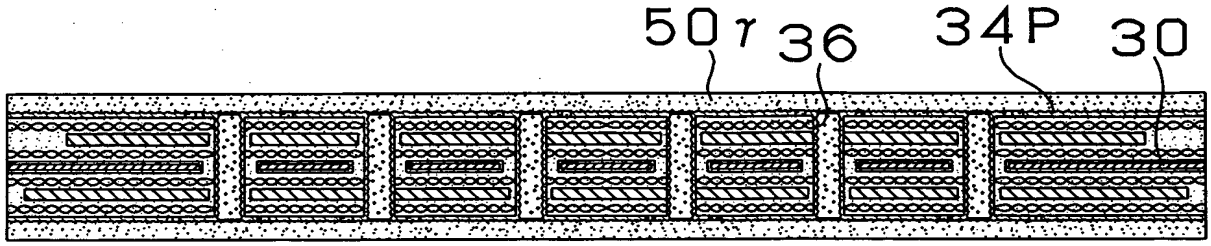
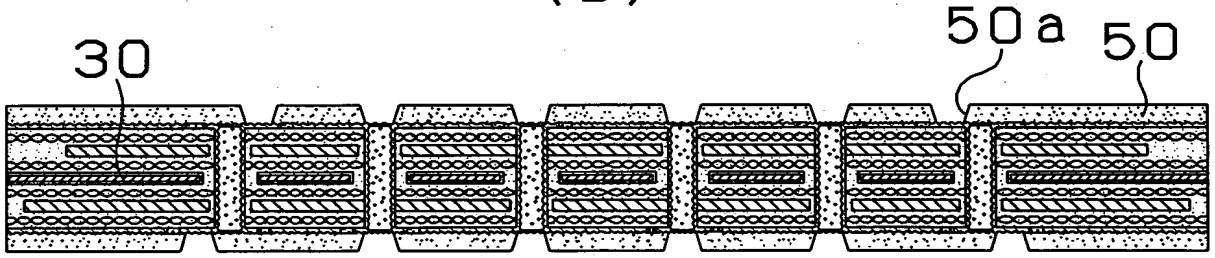
Fig.5

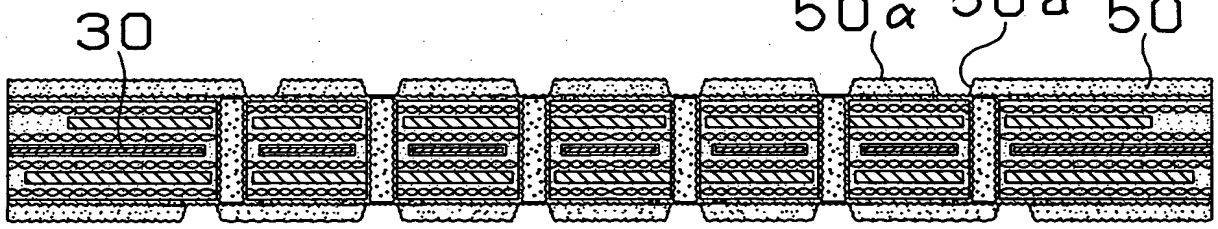
(A)



(B)



(C)



(D)

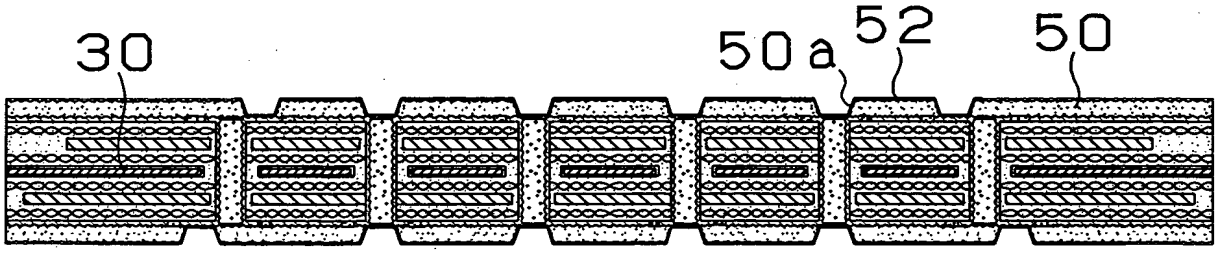


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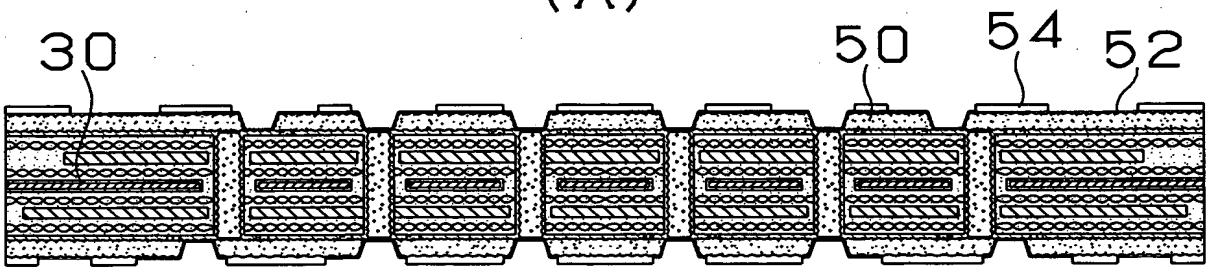
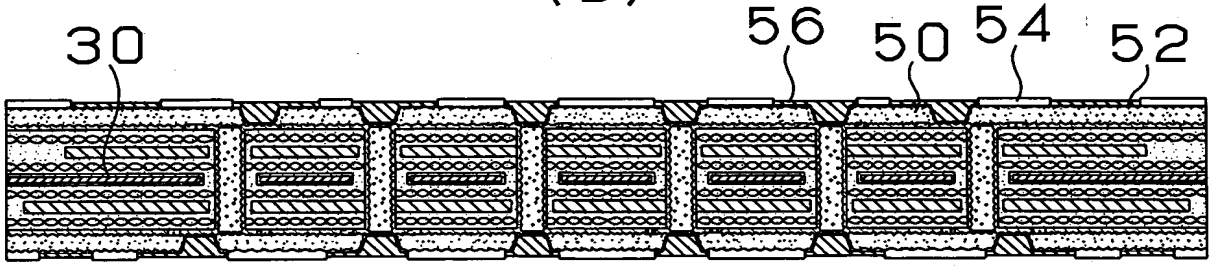
Fig.6

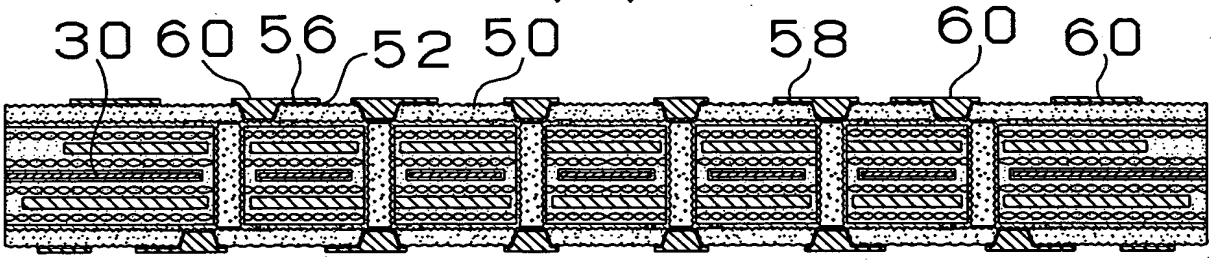
(A)



(B)



(C)



(D)

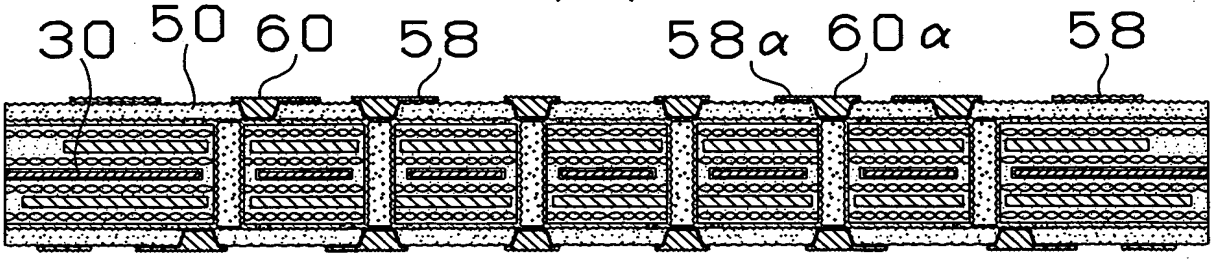


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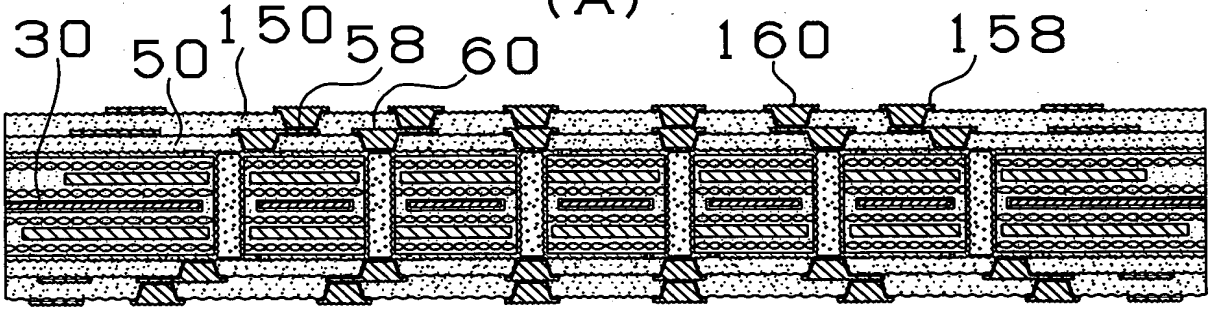
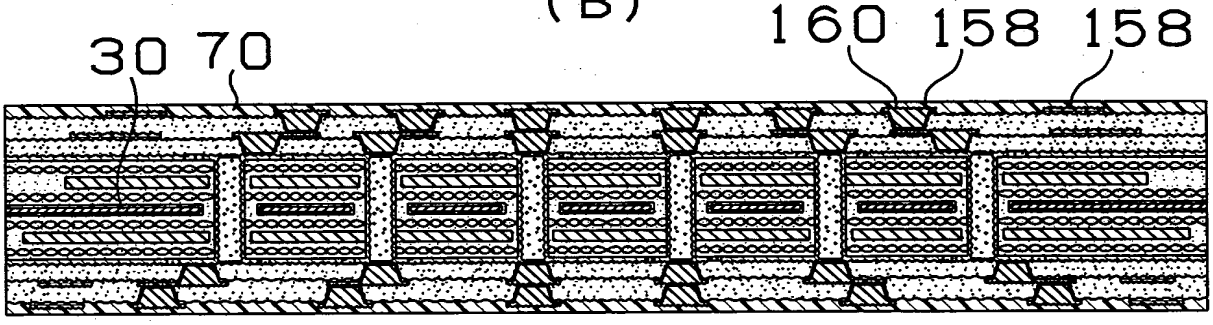
Fig.7

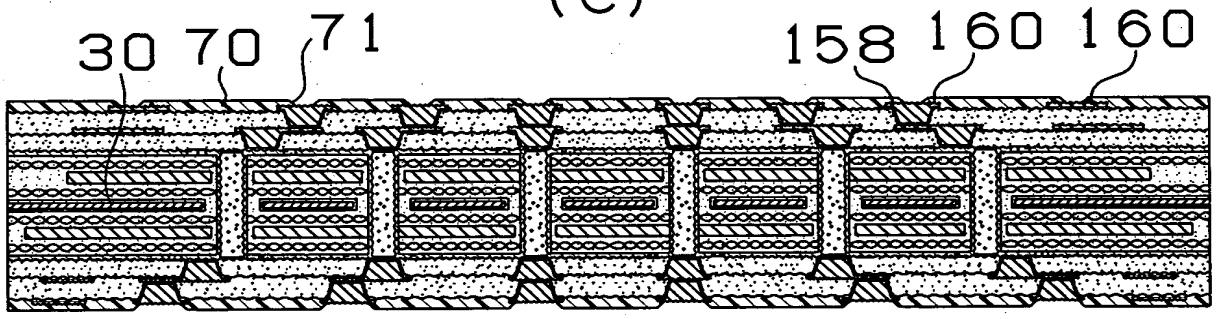
(A)



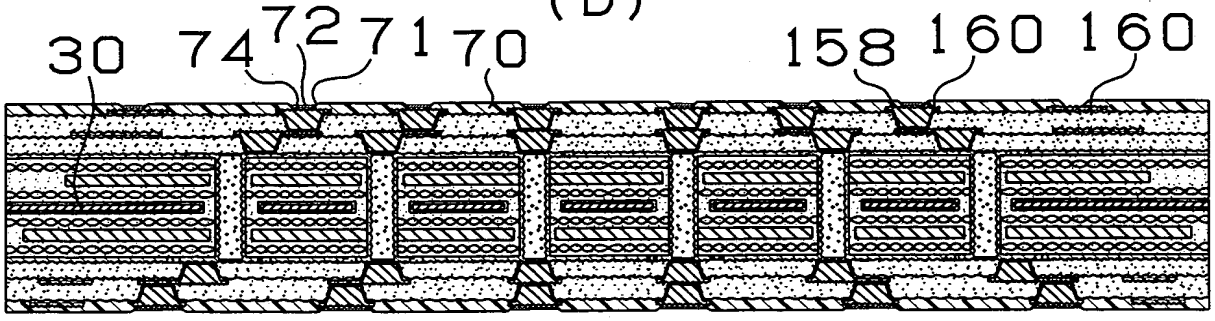
(B)



(C)



(D)



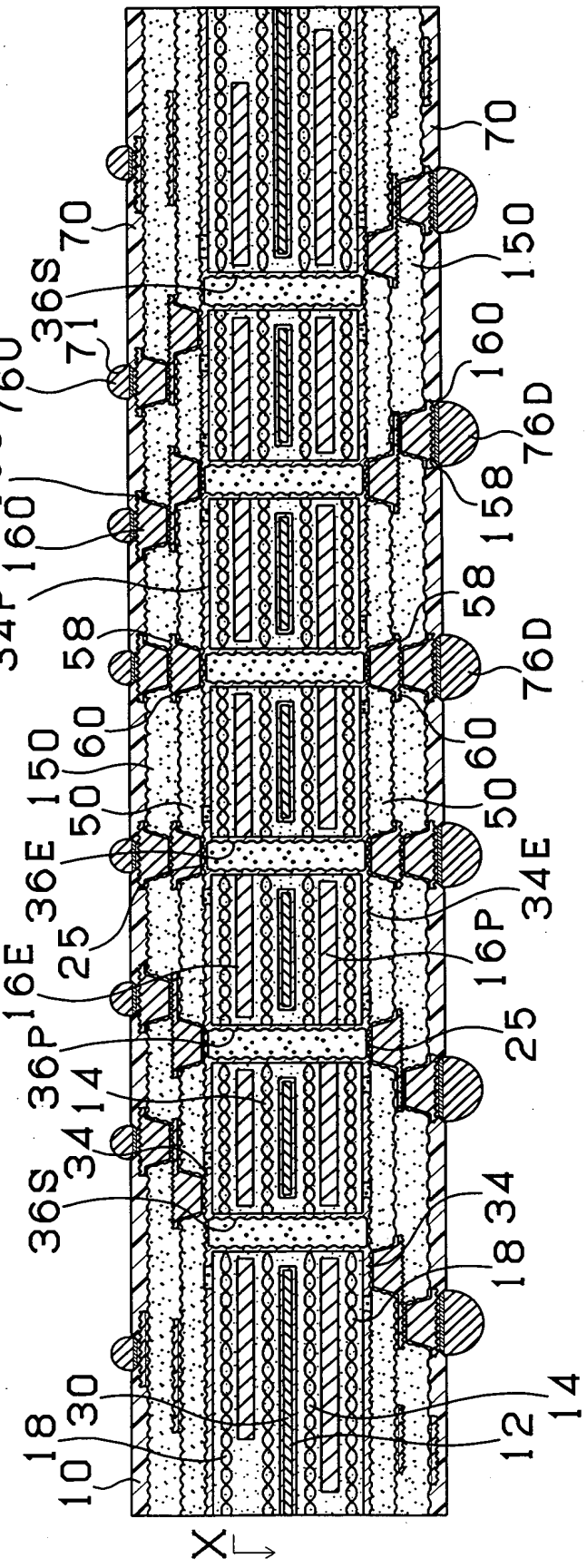

X
70
150
160
76D
158
58
76D
60
50
34E
16P
25
36S
34
18
14
12
X
10
30
18
36S
34
14
36P
16P
25
36E
50
60
150
58
34P
160
158
76U
71
36S
70

Fig.8

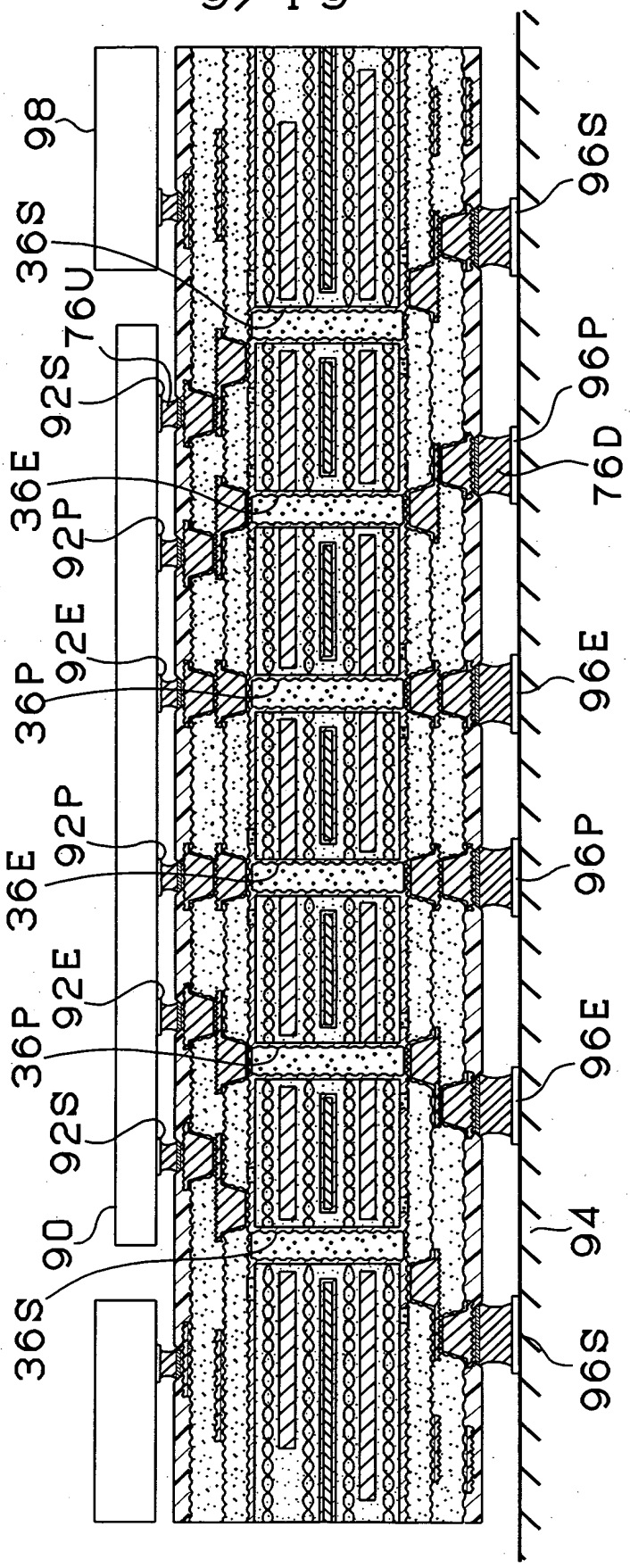

98
36S
76U
92S
36E
92P
92E
36P
92P
36E
92E
36P
92S
90
36S
96S
96P
76D
96E
96P
96E
94
96S

Fig.9

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Fig.10

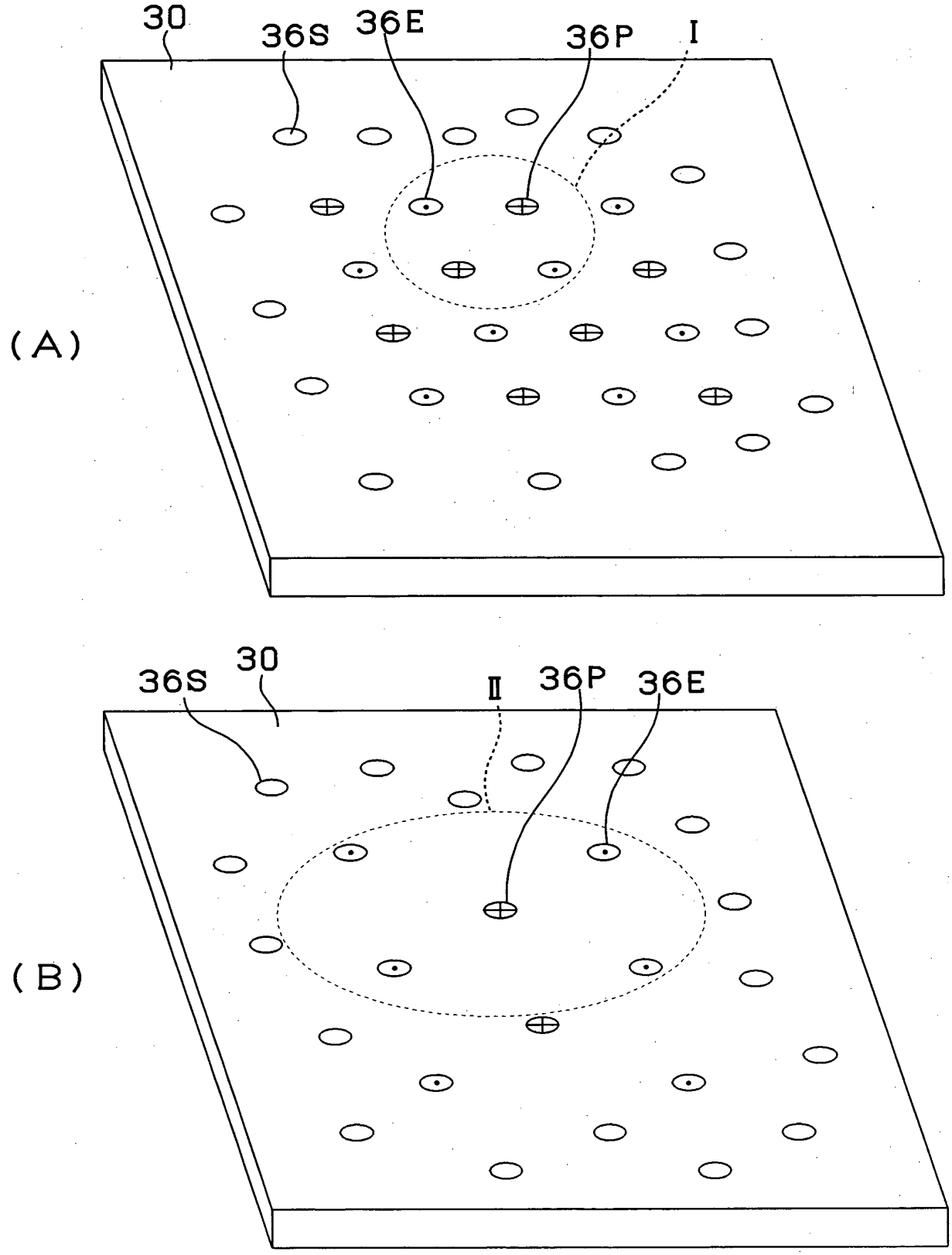

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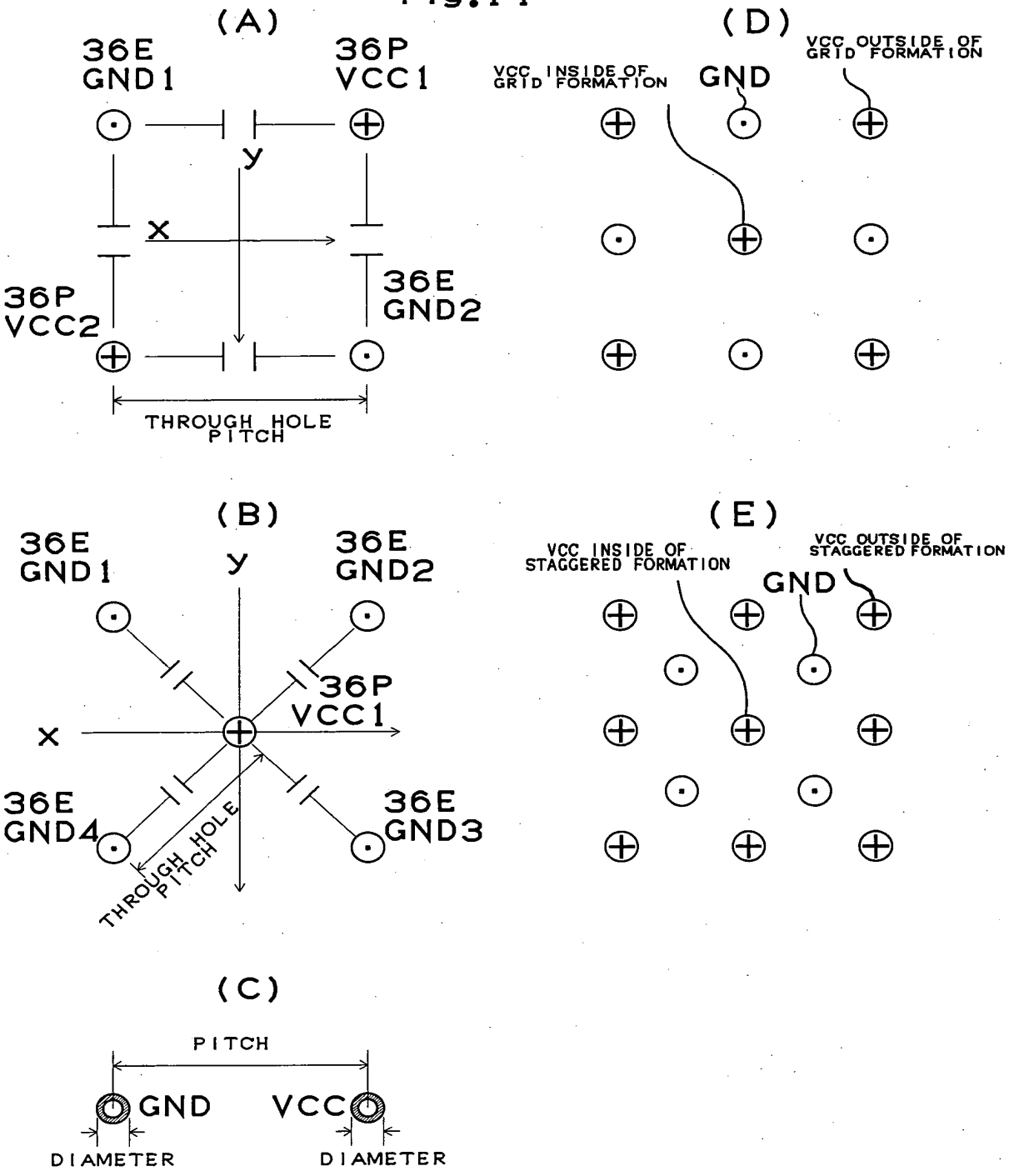
Fig.11


(A)
36E
GND1
36P
VCC1
y
x
36P
VCC2
36E
GND2
THROUGH HOLE
PITCH
(B)
36E
GND1
y
36E
GND2
36P
VCC1
x
36E
GND4
36E
GND3
THROUGH HOLE
PITCH
(C)
PITCH
GND
VCC
DIAMETER
DIAMETER
(D)
VCC INSIDE OF
GRID FORMATION
GND
VCC OUTSIDE OF
GRID FORMATION
(E)
VCC INSIDE OF
STAGGERED FORMATION
GND
VCC OUTSIDE OF
STAGGERED FORMATION

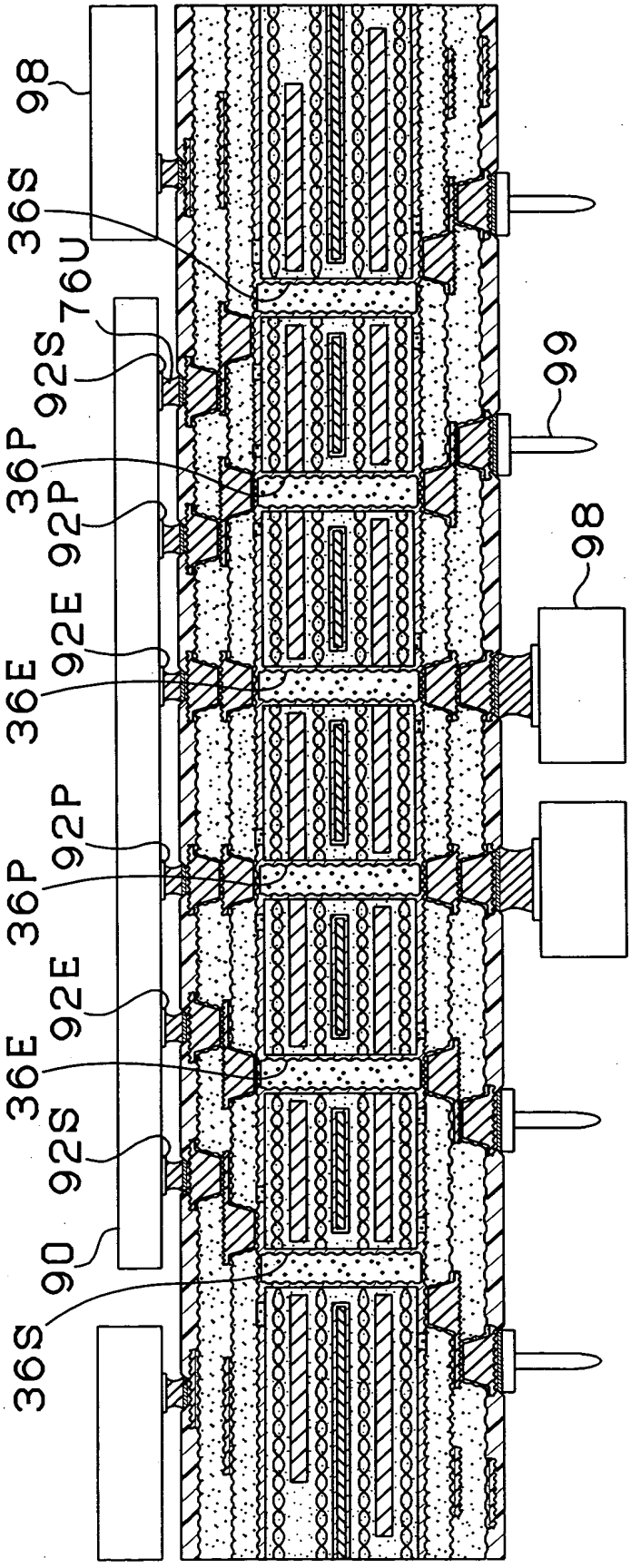


Fig.12

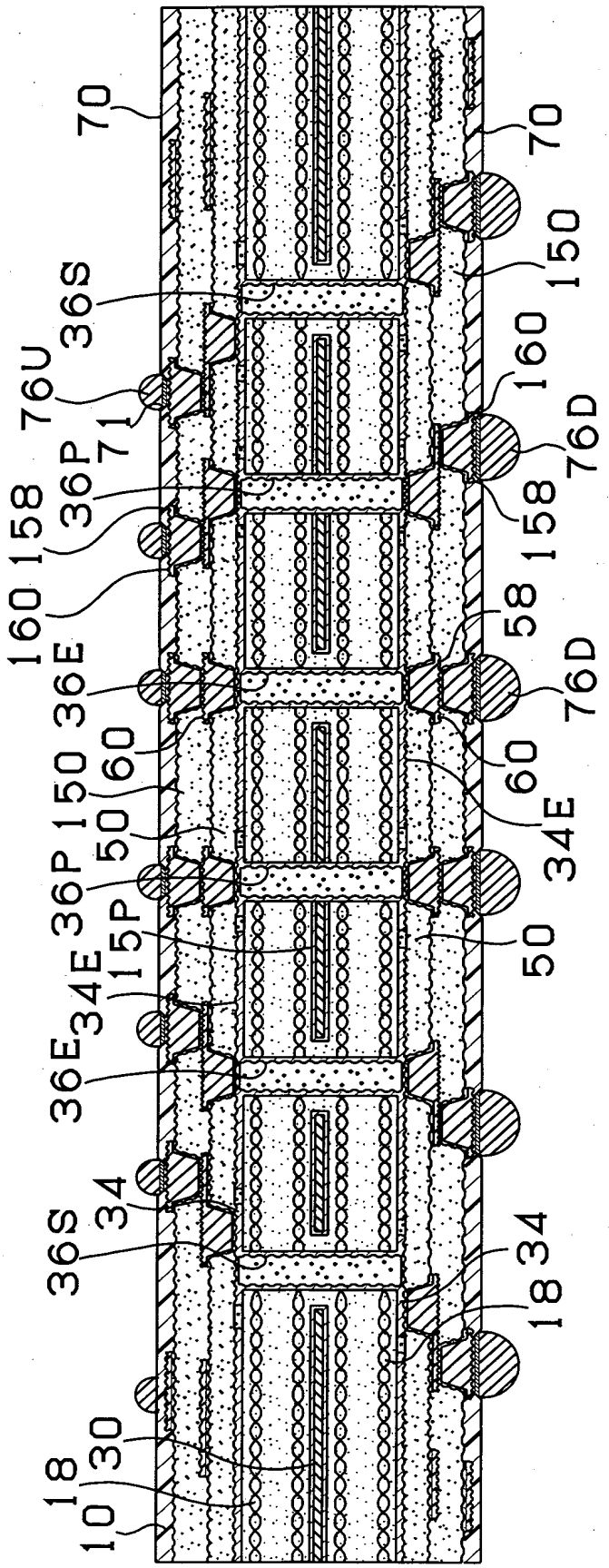

70
70
150
36S
160
76U
76D
71
36P
158
158
160
58
36E
76D
60
60
150
50
34E
36P
50
15P
34E
36E
36S
34
34
18
18
30
10

Fig.13

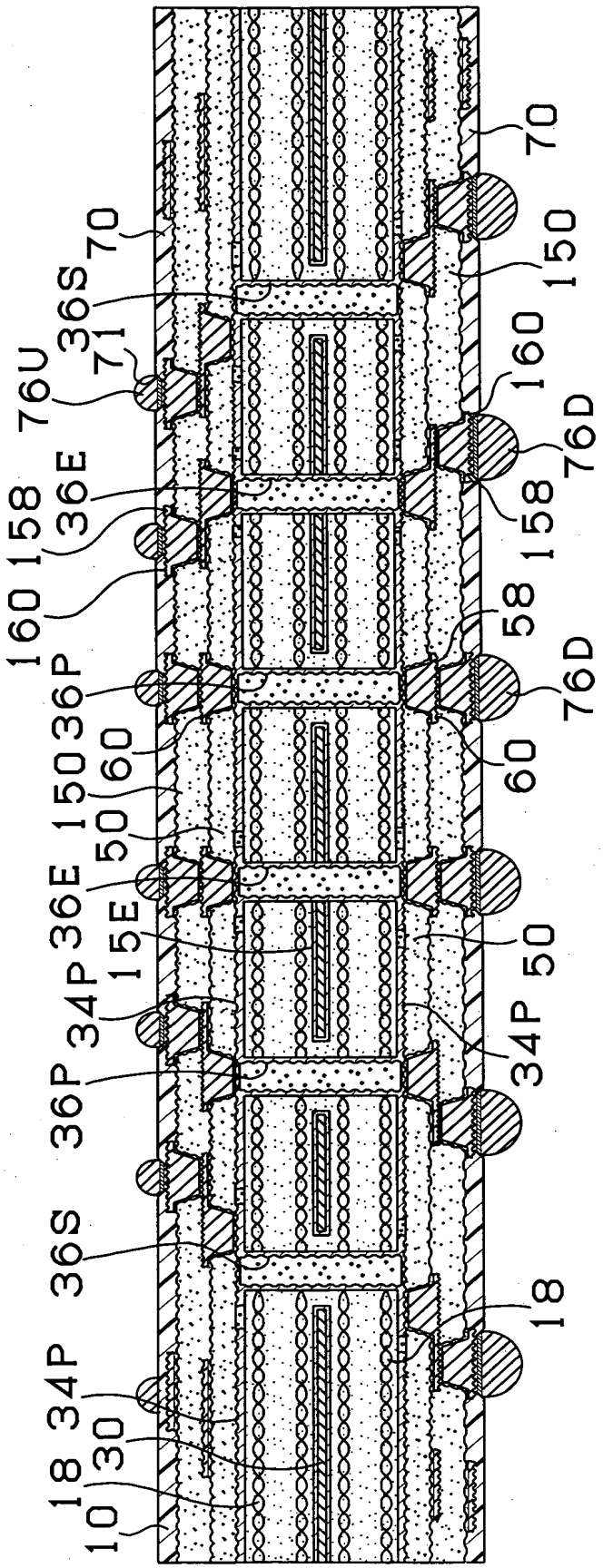


Fig.14

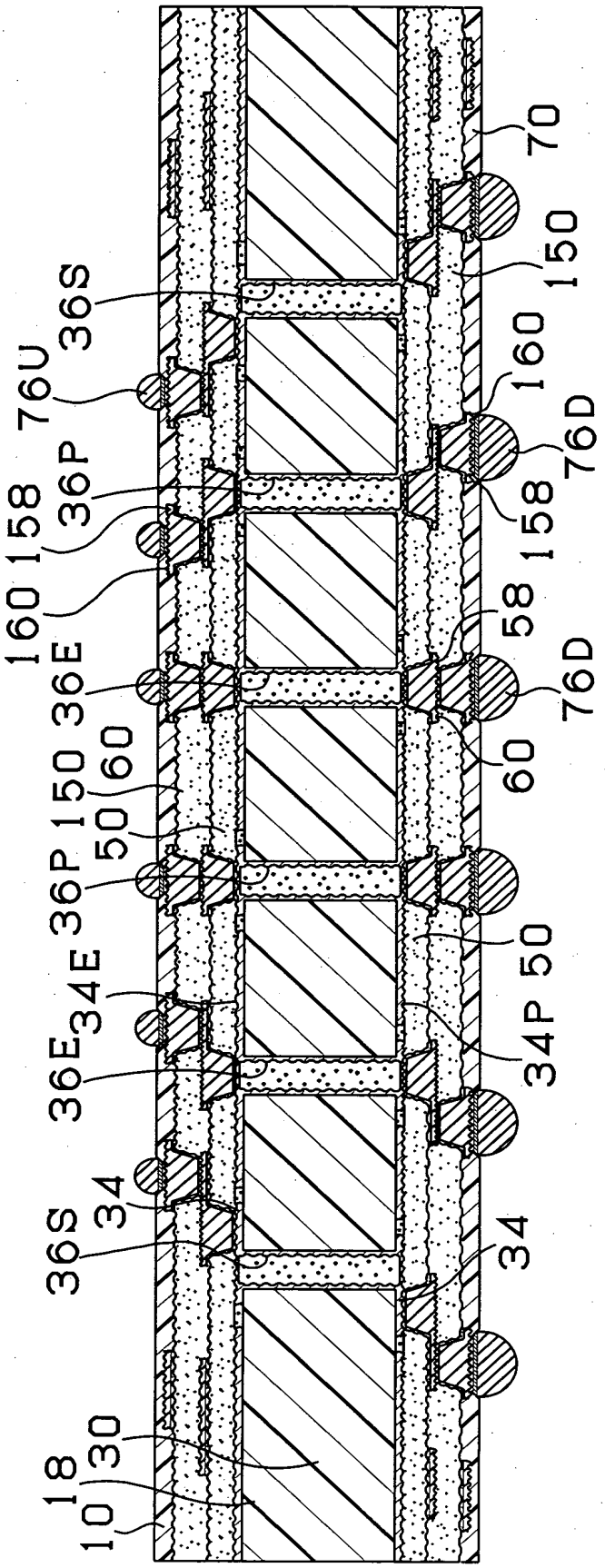

70
150
36S
160
76U
76D
36P
158
158
160
58
36E
76D
150
60
60
50
36P
50
34E
34P
36E
34
36S
34
18
30
10

Fig.15

Fig. 16

THROUGH HOLE PITCH (μm)	THROUGH HOLE DIAMETER (μm)	THICKNESS OF CORE SUBSTRATE (μm)	STAGGERED FORMATION (THICK COPPER) LOOP INDUCTANCE (pH)	GRID FORMATION LOOP INDUCTANCE (pH)	RANDOM FORMATION LOOP INDUCTANCE (pH)	FOURTH REFERENCE EXAMPLE LOOP INDUCTANCE (pH)
650	450	600	93	84	115	
600	400	600	87	75	109	88
550	350	600	73	59	100	75
500	300	600	73	56	95	75
475	275	600	63	57	90	65
450	250	600	59	55	85	62
425	225	600	58	55	85	60
400	200	600	59	55	—	60
80	50	600	55	50	90	57
50	25	600	63	60	—	

NOTE: A DIFFERENCE BETWEEN FOURTH REFERENCE EXAMPLE AND GRID FORMATION (THICK COPPER) IS JUST A SUM OF THICKNESSES OF CONDUCTIVE LAYERS IN MULTI-LAYER CORE SUBSTRATE.

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Fig. 17

(A)

	STAGGERED FORMATION (THICK COPPER)		GRID FORMATION (THICK COPPER)	
THROUGH HOEL PITCH (μm)	CRACK IN INSULATING LAYER	RESULT OF CONDUCTIVITY TEST	CRACK IN INSULATING LAYER	RESULT OF CONDUCTIVITY TEST
650	○	○	○	○
600	○	○	○	○
500	○	○	○	○
400	○	○	○	○
80	○	○	○	○
50	×	×	×	×

CRACK IN INSULATING LAYER : ○ NO CRACK × CRACK

RESULT OF CONDUCTIVITY TEST : ○ NO ABNORMALITY IN RESISTANCE

× ABNORMALITY IN RESISTANCE

(B)

	STAGGERED FORMATION	GRID FORMATION
THROUGH HOEL PITCH (μm)	LOOP INDUCTANCE (pH)	LOOP INDUCTANCE (pH)
650	93	84
600	87	75
550	73	60
500	63	56
475	63	57
450	59	55
425	58	54
400	55	52
350	54	50
300	54	50
200	53	50
100	54	49
75	54	49
60	55	50
50	63	60

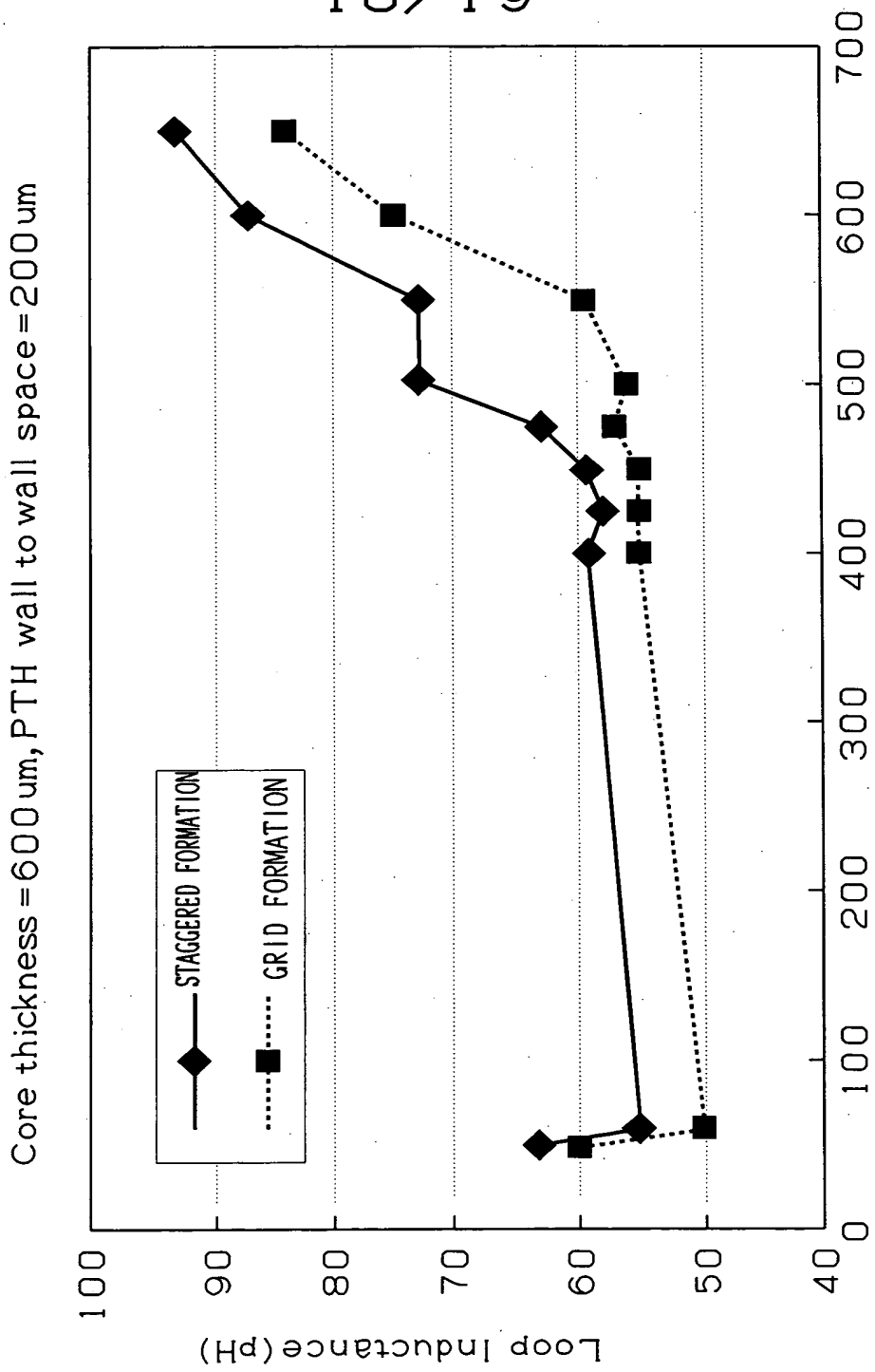
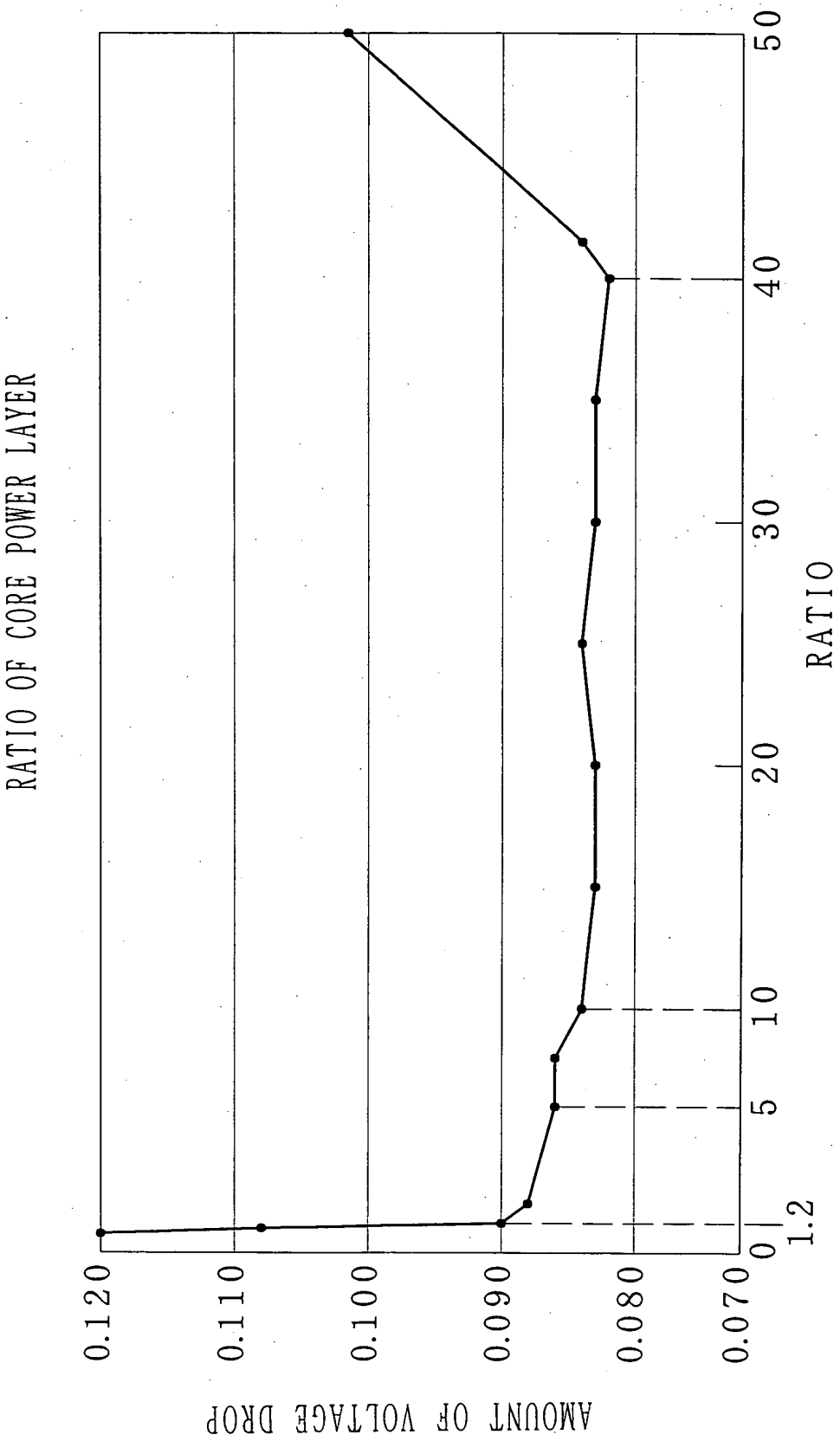

Core thickness=600um, PTH wall to wall space=200um
STAGGERED FORMATION
GRID FORMATION
Loop Inductance (pH)
PTH pitch(um)
100
90
80
70
60
50
40
0
100
200
300
400
500
600
700

Fig. 18

Fig. 19


RATIO OF CORE POWER LAYER
AMOUNT OF VOLTAGE DROP
0.120
0.110
0.100
0.090
0.080
0.070
0
1.2
5
10
20
30
40
50
RATIO